PB88-199443

Using SAS (Trade Name) Color Graphics for Video Image Analysis

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Research Triangle Park, NC

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

Apr 88

U.S. Department of Commerce
National Technical Information Service
NTIS

PB88-199443

EPA/600/D-88/076
April 1988

USING SAS COLOR GRAPHICS FOR VIDEO IMAGE ANALYSIS

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EPA Contract 68-01-7365

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National Technical Information Service
SPRINGFIELD, VA. 22161

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Using SAS(R) Color Graphics for Video Image Analysis

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PROBLEM

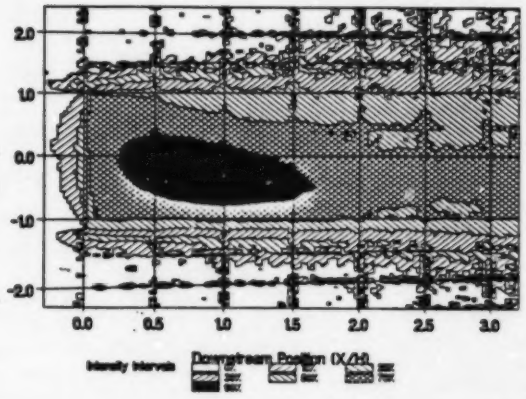
Wind-tunnel studies are conducted to evaluate the temporal and spatial distributions of pollutants in the wake of a model building. As part of these studies, video pictures of smoke are being used to study the dispersion patterns of pollution in the wake of buildings. The video image format has potential as a quantifiable electronic medium. Analysis of series of selected pixels (picture elements) for video images is used to evaluate temporal and spatial scales of smoke puffs in the wake of the building. Thirty black-and-white video pictures per second of a full field of view are recorded with a camera connected to a standard VHS recorder. The video luminous analog signal for each video image frame was digitized by a video sequence processor. The digitized luminous signal from the picture is on a 0 to 255 (8 bits) unitless gray scale. These values of video luminous intensity correspond to the density of smoke through the field of view. The resolution of each video image frame is 525 vertical pixels by 768 horizontal pixels. The digital representation of selected picture segments are stored on magnetic tape for later analysis. A comprehensive package of software is needed to manage the large database, to statistically evaluate the temporal and spatial scales of the images, and to generate visual displays of the results.

SOLUTION

Base SAS(R) software and SAS/GRAPH(R) procedures are being used to analyze the digital representation of the picture segments. Base SAS software is used to process data from magnetic tape into a SAS data library. DATA steps and PROCEDURE steps were employed to convert the raw data into SAS data sets containing normalized values. This poster presents a sample of SAS/GRAPH PROCEDURE applications used in the study.

As displayed in the poster, the origin of the x, y, z coordinate system coincides with the source of the emitted smoke. This simulated point source is located at floor level, midway along the leeward face of the model building. The vertical, lateral, and longitudinal scales are normalized by the height of the model building (H). The video intensity level is normalized and represents a percentage of the full-scale intensity.

The SAS/GRAPH PROCEDURE step, GCONTOUR, was used to display a three-dimensional image of the plume. The contour levels from the GCONTOUR procedure for the time-averaged pictures graphically represent the regions of the building wake flow.



The pattern-filled contour regions, depicting the intensity levels, were selected to emphasize the area of smoke recirculation in the immediate wake of the building. The selection of the contour levels depicts the frequency of high-intensity smoke shedding. The scale of the building can be visualized in the time-averaged side view. An ANNOTATE= data set was used to draw major tick marks and reference lines, and placed bold values and labels along the vertical and horizontal axes. The LEGEND statement was utilized to specify the variable label and to associate a quoted string with a tick mark. In the following figure, the building is situated upwind of the source (i.e. X/H < 0.0) with its width positioned from Y/H = -1 to 1.

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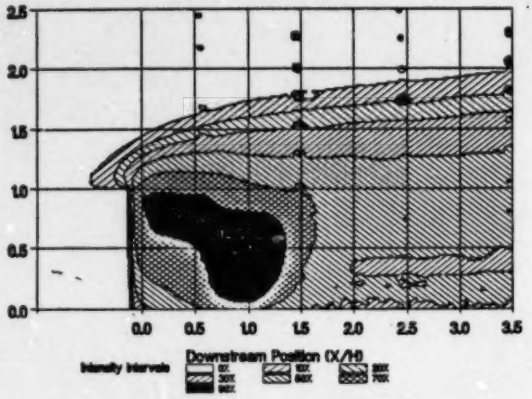
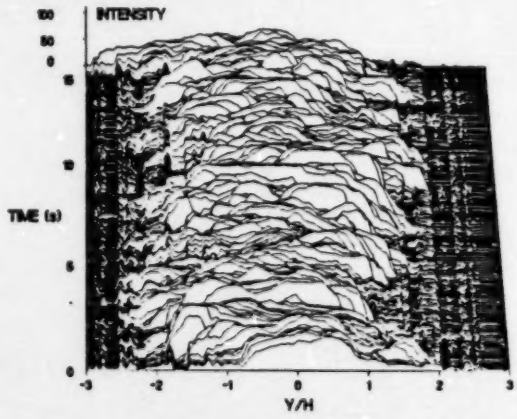
* On assignment from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce



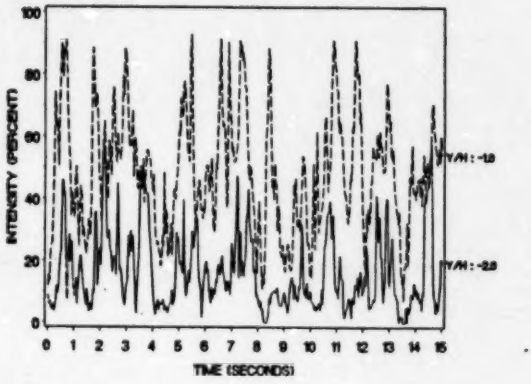
The creation of the ANNOTATE= data set for the placement of reference lines was particularly useful. Since the pictures were somewhat distorted, the vertical reference lines did not appear to be horizontal. With the use of the MOVE and DRAW functions, the reference lines were generated to account for the distortion. The axes values and labels were also annotated in the same fashion as the time-averaged side view.

At a fixed position downstream, time sequences of cross-stream profiles are collected for analysis and display. The G3D procedure was used to illustrate the fluctuations in intensity over time.

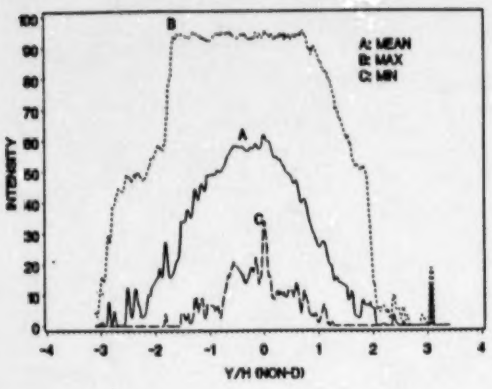


The three-dimensional surface qualitatively depicts the relative movement of the plume from side to side across the fixed downstream location. Because of the specified tilt and rotation of the axes, the values and labels had to be repositioned so they would not interfere with the axes. Hence, the ANNOTATE= data set, along with the NOLEGEND option and an unprintable character string in the TITLE statement, positioned the text as illustrated.

The MEANS procedure calculates statistics, such as the standard deviation, coefficient of variation, and skewness, that characterize both the instantaneous and time-averaged plume. The GPLOT procedure, using the OVERLAY option and ANNOTATE= data set, displays the output statistics. The variations of statistics for the instantaneous plume are evaluated. The intensity signal at two cross-stream positions for the instantaneous plume is plotted on the same axes in order to examine high intensities and plume oscillation.



The coordinates for the placement of plot labels are based on the values in the last observation. With the negative rotation of an unprintable character string, four character cells high, in the TITLE statement, extra space is added to the right-hand side of the plot frame. The minimum, mean, maximum, standard deviation of the intensity, skewness, and coefficient of variation for the cross-stream distribution of the time-averaged plume are evaluated. In the following figure, the ANNOTATE= data set for the plot of the minimum, mean, and maximum intensity contained the commands which were needed to place text on each statistical profile and to position a legend within the axis frame.



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